REQUIREMENTS FOR COTTON INSECTICIDES IN THE UNITED STATES

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Introduction

Profitable production of cotton often involves the timely use of effective insecticides to control the boll weevil and other cotton insects. Research is continually improving methods and procedures for utilizing insecticides more effectively. As a result of this research, insect control has been brought within the economic reach of cotton growers generally.

Damage Caused by Cotton Insects

The cotton plant is affected by many kinds of destructive insects. Although the boll weevil is the most notorious of these pests over most of the Cotton Belt, certain caterpillars, sucking bugs, plant lice, other insects, and spider mites add to pest control problems wherever cotton is grown in the United States. The Bureau of Agricultural Economics, United States Department of Agriculture, has published figures for the years from 1909 to the present showing the estimated reduction from full yield of cotton due to a number of factors. The boll weevil has caused about 76 percent of the reduction in yield of cotton that was due to insects in the Cotton Belt since 1909. It reduced the cotton yield by over 30 percent in 1921 and from 15 to 20 percent in some seasons since that year. Average reduction since 1909 has been about 10 percent for the boll weevil and nearly 14 percent for all insects. Peak years of boll weevil damage have occurred every three to six years since 1916, with an average period between peaks of 4.8 years. Stated in another way, reduction in yield of as much as 13 percent because of weevil activities in the entire Cotton Belt has occurred in eight seasons in the last 30 years. Weevil activity of this degree extended over three seasons from 1927 to 1929 and over the two years 1949 and 1950. The remaining three years when yields were reduced as much as 13 percent were 1932, 1941, and 1946.

The reduction in cotton yield due to the boll weevil for the period from 1938 to 1952 inclusive was greatest in those states from Virginia to Florida and westward along the Gulf to Louisiana. In this area the 15-year State averages ranged from 11.8 to 16.2 percent. In Tennessee, Arkansas, Oklahoma, and Texas the 15-year average reduction was from 3.7 to 8.5 percent.

During the fifteen-year period from 1938 through 1952 the acreage of cotton harvested each year averaged over 22,000,000 acres. This immense acreage was exceeded only by that for corn, wheat, oats, or all hay. Because serious insect infestations in some years may cause the entire loss of the cotton crop in untreated fields, cotton insecticide consumption may at times be exceedingly heavy. In other years, the crop may be so reduced by weather conditions unfavorable to both the cotton plants and the associated insects that consumption of cotton insecticides will be relatively light. Despite a growing tendency toward more general usage of cotton poisons, consumption of these materials in the boll weevil area from Texas and Oklahoma eastward was more than 40 percent lower in 1952 than in 1951, largely because of weather conditions unfavorable to the crop.

Benefits from Use of Cotton Insecticides

Many factors may assist in increasing crop yields. However, ample evidence exists that by itself application of insecticides to cotton in accordance with recognized insect control practices increases yields. In a North Carolina series of twenty large-scale comparisons made in 1952 the average yield was increased from 377 pounds per acre in untreated fields to 485 pounds in treated ones. The overall yield for surveyed acreage in the same State (about 78 percent of the total area in cotton) was 421 pounds per acre for treated fields and 322 pounds for untreated ones.

The profit which can be derived from proper use of insecticides to control insects on cotton has been demonstrated in community-wide experiments in central Texas. In 1949 nineteen adjoining fields in one community were dusted or sprayed with insecticides properly timed according to the particular types of insects in each field. Fourteen fields in another nearby community received no insecticide treatments, but all other factors in the management of the crop were the same as those in the treated fields. The average yield in lint cotton was 415 pounds per acre from the treated fields as compared with 178 pounds from the untreated fields. The net profit from increased yields of lint cotton was $54 per acre. A similar large-scale demonstration carried out in 1950 gave an average net gain based on increased yields of lint cotton of $74.84 per acre.

Cost of Application

Oklahoma growers in 1952 made between 2 and 3 applications of poison to 337,639 acres at a cost of $812,828. Their average cost per acre accordingly was $2.41. In a contest involving five-acre fields of cotton in Mississippi one contestant reported his cost of applying 10 dustings to be $11 per acre while another spent $35.80 per acre to make 17 applications.

The cost of application, exclusive of materials, has been estimated at 50 cents an acre for dusting and 75 cents for spraying. The overall average cost each year from 1950 to 1952 to the cotton growers of the United States for applying insecticides to their crop was probably at least $80,000,000.

Volume of Insecticides Applied to Cotton

Since World War II the commercial development for agricultural purposes of such organic insecticides as DDT, benzene hexachloride, toxaphene, aldrin, dieldrin, and heptachlor revolutionized the control of cotton insects. Growers became less dependent upon the single important cotton insecticide, calcium arsenate. The control of numerous destructive pests of cotton not heretofore controllable was made possible, and the volume of special mixtures formulated ready to apply increased phenomenally. For instance, 1942 was a year of high calcium arsenate consumption, disappearance of this chemical at the producers' level that season amounting to 67,250,000 pounds. Of this quantity 89 percent went to the Cotton South. By 1950, 381,000,000 pounds of formulated dust mixtures (including 33,400,000 pounds of calcium arsenate) and 5,260,000 gallons of spray concentrates were used on cotton in the United States. Only 7 percent of the quantity used that year was calcium arsenate, 36 percent being benzene hexachloride and 57 percent other chlorine - containing organics.

Overall consumption of formulated cotton poisons has remained at a relatively high level since 1950, subject to the normal fluctuations of boll weevil populations. In 1951 consumption in the boll weevil area was 24 percent higher than in 1950; in 1952 it was 27 percent lower; and in 1953 it rose again somewhat. As explained later in this paper, consumption on cotton is not necessarily in direct proportion to infestation.

Calcium arsenate is not adapted to application to cotton as a spray, hence the established practice for many years has been to use the insecticide solely as a dust. Since the development of organic chemicals which could be used in either dust or spray form, it has been found that sprays are generally more advantageous. As a consequence the percentage of liquid cotton poisons applied in the boll weevil area is now from 30 to 50 percent of the total. The overall proportion depends upon the level of insect control in different parts of the area because the use of sprays is more prevalent west of Alabama than in the Southeast.

Prior to 1947, when the arsenical compounds, mostly calcium arsenate, were the sole poisons available to control the boll weevil, only 5 to 10 percent of the cotton acreage in the Cotton Belt was treated each year. The newer synthetic organic insecticides which control not only the boll weevil but also other insects now recognized as being highly destructive, were used in 1950 and 1951 together with calcium arsenate

on probably about 35 to 40 percent of the cotton acreage over the entire boll weevil area. In South Carolina 81 percent of the acreage was treated in 1950, and about the same proportion in Mississippi.

From 80 to 95 percent of the domestic usage of aldrin, dieldrin, heptachlor, and toxaphene probably has been on the cotton crop. Consumption of calcium arsenate and benzene hexachloride is somewhat less dependent upon infestations on cotton, yet from 65 to 85 percent of these materials probably also have been applied here. DDT has a much broader use base, being used on many crops and in other types of locations. It is estimated that only 20 to 30 percent of the DDT which is used in the United States is consumed in the formulation of cotton insecticides. DDT will not control the boll weevil and several other important pests of cotton but it is included in many insecticidal mixtures for the control of such insects as the bollworm, the pink bollworm and various plant bugs and stink bugs. It is used extensively, therefore, on cotton grown west of the boll weevil area.

Some Factors Related to Demand and Usage of Cotton Insecticides

Estimation of future requirements for cotton insecticides is complicated and difficult. This is due to the impossibility of predicting accurately the abundance of the various kinds of insect pests and the date and location of infestations. It is necessary to apply control measures rather regularly against some insects. For these, knowledge of the area concerned and the average rate of application would permit the requirement for particular chemicals to be calculated with fair precision. Many of the most destructive insect pests, however, do not appear in damaging numbers every year. One of these is the boll weevil which in some years is not seriously injurious to cotton. In such years insecticides for its control may not be in great demand in considerable areas of the Cotton Belt. Probably the most important factor affecting the extent and degree of insect infestations, particularly of the boll weevil, is the severity of the winter and the character of the weather during the growing season. Changes in total cotton acreage are significant in estimating requirements only if they affect specific areas where the rate of consumption is reasonably uniform from year to year (Table 1). The study of past trends in consumption and the consideration of expected changes in insect control practice are the most reliable means of determining requirements of insecticides.

Table 1. Comparison of the total cotton acreage and the consumption of cotton insecticides in terms of field strength dust

Year	Acres of cotton under cultivation July 1st	Cotton insecticides consumed in terms of pounds of field strength dust
1950	15,845,000	502,000,000
1951	25,860,000	622,000,000
1952	24,521,000 1/	366,000,000

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The number of adult boll weevils that have survived hibernation in different sections of the Cotton Belt is a subject of much interest each spring to those concerned with cotton production. The number of days from September to March on which the temperature falls below 32°F. is correlated with the number of boll weevils found in cotton fields during May and June. It is these survivors that will, under favorable conditions, rapidly increase and become destructive in July and August.

Hot dry weather is unfavorable for the development of the boll weevil, whereas frequent rains provide good conditions for the growth of both cotton and the weevil. By frequent rains is meant precipitation of 0.03 inch or more on eight to ten of the days between June 21 and August 19. In seasons and localities in the Cotton Belt having such rainfall it is likely that boll weevil injury will be heavy in fields untreated with insecticides.

Many cotton farmers do not apply poison to the crop until insect damage becomes evident and adequate stocks of insecticides are generally not carried by the grower or his local dealer. A sudden and heavy demand may reach chemical manufacturers who are quite unprepared, and a shortage of insecticides may develop which cannot be overcome before the end of the season. For one or two years after a season such as 1950 when boll weevil injury was severe, cotton poisons remain in much demand. Chemical manufacturers and insecticide formulators are encouraged to maintain a high level of production. The history of calcium arsenate production demonstrates that more cotton poison may be sold the year following than during a peak year itself of boll weevil activity. When demand suddenly disappears, the producers find themselves with capital tied up in considerable inventories involving serious storage problems.

If sufficient cotton poisons to meet at least minimum needs were stocked locally by dealers and growers or placed on order well ahead of the growing season, this practice would tend to avoid serious shortages of poison and help to assure the production of a good crop despite the sudden appearance of heavy populations of the boll weevil. Manufacturers of insecticides would be better able to schedule their production and serve the grower by providing for his requirements of these essential materials. It does not appear likely, however, that local storage of significant quantities of cotton insecticides will become general in the near future. As a result manufacturers and formulators are forced to add to their costs a charge for storage of much of the carryover of insecticides from one season to the next.